HNR

MECHANICAL CALCULATION COVER SHEET

Calculation No:3442.053.MCAL.002,
Calculation Title: ENERGY AND MAINTENANCE COST ANALYSIS
Project ID # 100256
Project Title: CCN CHILLED WATER SYSTEM OPTIMIZATION MASTER PLAN

ORIGINAL AND REVISED CALCULATION/ANALYSIS APPROVAL

	Rev._A Name/Signature/Date	Rev. B Name/Signature/Date	Rev._0 Name/Signature/Date
Originator: DAVID WALKER	10/16/01		09/04/02
Checked By: MIKE SLAMAN	10/16/01		09/04/02
Approved By: MIKE SLAMAN	10/16/01		09/04/02
Other:			

AFFECTED DOCUMENTS

Document Number	Document Title	Rev. Number
3442.053.ECAL.001	Short Circuit Analysis of SUS-H & MCC-1	0
3442.053.MCAL.00 1 through .006	CCF/LDCC COOLING PLANT MODIFICATIONS sheets G-0001, M0001 through M-8006, and E-0001 through E-7007	0
3442.053.MCAL.00 1 through .006.	LDCC EC-1 MODIFICATIONS sheets G-0001, M-0001 through M-8006, and E-0001 through E-7007.	0

Record of Revision

Rev.	Reason for Revision
REV A	FIRST SUBMITTAL OF CALCULATIONS
REV 0	ISSUED FOR CONSTRUCTION. NO TECHNICAL CHANGES FROM REV A. CHANGES TO THE AFFECTED DOCUMENTS ONLY, AS NOTED ABOVE.

Holmes & Narver | Raytheon

CALCULATION CHECKLIST

Task/Project #: 100256
Task Order 053
CCN CHILLED WATER SYSTEM OPTIMIZATION MASTER PLAN

Calculation Number: 3442.053.MCAL.002 | Revision A0 PAW

Reviewer/Checker : MIKE SLAMAN | Date 10/16/01

Reviewer performed or supervised subject calculation.
✓ NO ____ YES Justification Attachment _____, _____ pages

Alternate Verification method approved _____ Method _____

ITEM(S) CHECKED	Accept Y/N	OBJECTIVE EVIDENCE Sheets		INITIAL/ DATE 10/16/01
1. Cover forms properly completed.	Y			✓
2. Calculation Sheet headers complete with calc. no., rev., etc.	Y			✓
3. Calculation Sheet contents complete per format.	Y			✓
4. Listed attachments included.	N/A			
5. Calculation Objective clearly described.	Y			✓
6. Criteria are suitable and properly referenced to task-specific documents.	Y			✓
7. Assumptions and data described and attached or referenced to task documents.	Y 7			✓
8. Calculation method identified and appropriate for the design activity.	Y 8			✓
9. Calculation results reasonable and correctly described in Results and Conclusions.	Y 9			✓
10. Computer Program identified with version and revision.	N/A 10			
11. Computer Program references method used, etc.	N/A 11			
12. Computer input/output provided.	N/A 12			
13. Computer run traceable to calculation.	N/A 13			
14. Computer input data within permissible design input range.	N/A 14			
15. Computer Program validation/verification addressed.	N/A 15			

REMARKS

Mike Slaman Date 10/16/01
Checker Print Name & Sign
MIKE SLAMAN

David E. Walker Date 10/16/01
Preparer Print Name & Sign
DAVID WALKER

HNR
Holmes & Narver | Raytheon

MECHANICAL
DESIGN CALCULATION SHEET

Project Title: CCN CHILLED WATER SYSTEM OPTIMIZATION MASTER PLAN

Project ID #100256

Calculation No.
3442.053.MCAL.002

Rev. No. XO (DZW)

Calculation Title: ENERGY AND MAINTENANCE COST ANALYSIS

PERFORMED BY : David S. Walker 10/16/01 DATE
DAVID WALKER

CHECKED BY Mike Slaman 10/16/01 DATE
MIKE SLAMAN

INTRODUCTION

Purpose: The "Statement of Work" provided from LANL dated 7/24/01 states " Provide feasibility and Title II services to connect the CCF chilled water plant to the LDCC plant such that CCF chillers will be shut down and removed and the LDCC plant will be supplying chilled water to the CCF and outlying buildings." This work requires several objectives.

Scope:
1. Provide economic justification for eliminating the CCF chiller plant and cooling tower 285.

DESIGN BASIS

Design Inputs:
1. Test and Balance data performed by the Kirk Air Co. on 7/17/01 for CCF and Ambient Air Balance Co. for LDCC on 02/02/90.
2. LDCC equipment room 189 cooling load calculations for LDCC Chiller Replacement Project I.D. 100015.
3. Results from the pipe model program "Pipe Flo" created by Engineered Software INC. See Calculaltion M003.
4. Field data- e.g. "equipment tag information and rated motor horse power, etc."

Criteria: LANL electrical billing rates for large users.

Assumptions:
1. The LDCC and CCF chiller plants operate 24 hrs/day/ 7days/week, and 52 weeks/year.
2. The cooling load in both the LDCC and CCF building systems is more or less constant due to the cooling requirements of computers.
3. Once the two chiller systems are combined into the LDCC chiller plant, The 900 ton more efficient chiller will be used as the primary chiller and will be loaded to 100% capacity.

REFERENCES: Test and Balance data and utility electrical rates

METHODS: Identify all pieces of equipment that utilize energy. Determine annual usage hours and power consumption. Multiply the annual Kilowatt-hr by the electrical usage rate to determine the annual cost of operation. Due this procedure for both CCF and LDCC chiller plants separate and combined.

RESULTS AND CONCLUSIONS: There is significant energy and cost savings by eliminating the CCF chiller plant and cooling tower 285.

LDCC Chiller Plant Annual Energy Usage

700 ton Chiller

545 tons × .58 KW/ton × 8766 hrs/yr × $0.0738/kwh = $204,495.00

@ 2,770,933 kwh/yr

Primary chilled water Pump

15 hp × .746 KW/hp × 8766 hrs/yr × $0.0738/kwH = $7,239.00

@ 98,092 kwh/yr

Secondary chilled Water Pumps

40 hp × .746 KW/hp × 8766 Hrs/yr × $0.0738/kwH X2 = $38,609.00

@ 523,155 kwH/yr

Primary Cooling Tower Pump

125 hp × .746 KW/hp × 8766 hrs/yr × $0.0738/kwh = $60,326.00

@ 817,430 kwh/yr

Secondary Cooling Tower Pump

40 hp × .746 KW/hp × 8766 hrs/yr × $0.0738/kwh = $19,304.00

@ 261,577 kwh/yr

LDCC Chiller Plant Annual Energy Use Cont.

Cooling Tower Fans

VFD controlled (Assumed Value)

40hp x .70 x 1 Fan x .746 kw/hp x 8766 hrs/yr x $0.0738/kwh = $13,513.00

@ 183,104 kwh/yr

Cooling Tower Water Usage (Evap + Blowdown + Drift)

Compressor Heat

Evap: 1.25 x 545 tons x 12,000 BTU/ton x kw/1000 BTU x 8766 hr/yr x 1 gal/8.346 lbs x $1.42/1000 gal = $12,193.00

Blowdown: Evap/(cycles-1) = 8,586,395 gal/(2.5-1) x $1.42/1000 gal = $8,128.00

Drift: .2% x Flow = .002 x 6600 gpm x 60 min/hr x 8766 hr/yr x $1.42/1000 gal = $9,859.00

Air Handling Unit EC-1

Water: 750 lbs/HR x 3672 hrs/yr x gallon/8.346 lbs x $1.42/1000 gal = $469.00

Fans: 14.5 bhp x 2 Fans x .746 kw/hp x 8766 hrs x $0.0738/kwh = $13,996.00

@ 189,645 kwh/yr

Exhausts Fans EF-5,6,&7

5.6 Bhp x 2 Fans x .746 kw/hp x 8766 hrs/yr x $0.0738/kwh = $5,405.00

@ 73242 kwh

Total Annual LDCC plant Energy Usage = 417,178 kwh

Total Annual LDCC plant Energy + Water cost = $393,536.00

BRIDGERS & PAXTON CONSULTING ENGINEERS, INC.

JOB CCH Chilled Water Sys. opt. PL SHEET 3 OF 8
CALCULATED BY DJW DATE 10/16/01
CHECKED BY [illegible] DATE 10/16/01
3442.053.MCAL.002,Rev A SCALE JOB #
CONDENSED WATER Calc

CCF Chiller Plant Annual Energy Usage

500 ton chillers

$$795 \text{ tons} \times 0.58 \frac{\text{kW}}{\text{ton}} \times 8766 \frac{\text{hrs}}{\text{YR}} \times \$0.0738 \frac{}{\text{kWH}} = \$298,300.00$$

@ 4,042,003 kWH/YR

Primary chilled water pumps

$$40 \text{ hp} \times 2 \times .746 \frac{\text{kW}}{\text{hp}} \times 8766 \frac{\text{hrs}}{\text{YR}} \times \$0.0738 \frac{}{\text{kwh}} = \$38,609.00$$

@ 523,155 $\frac{\text{kwh}}{\text{YR}}$

Cooling Tower pumps

$$100 \text{ hp} \times 2 \text{ pumps} \times .746 \frac{\text{kW}}{\text{hp}} \times 8766 \frac{\text{hrs}}{\text{YR}} \times \$0.0738 \frac{}{\text{kwh}} = \$96,522.00$$

@ 1,307,887 $\frac{\text{kwh}}{\text{YR}}$

Cooling Tower Fan Motors

$$25\text{hp} \times 2\text{Fans} \times .746 \frac{\text{kW}}{\text{hp}} \times 8766 \frac{\text{hrs}}{\text{YR}} \times \$0.0738 \frac{}{\text{kWH}} = \$24,131.00$$

@ 326,972 kwh/yr

Cooling Tower Water Usage (EVAP + Blowdown + Drift)

EVAP: $1.25 \times 795 \text{ tons} \times 8766 \frac{\text{hrs}}{\text{YR}} \times \frac{12000 \text{ Btuh}}{\text{ton}} \times \frac{1 \text{ lbw}}{1000 \text{ Btu}} \times \frac{1 \text{ gal}}{8.346 \text{ lbw}} \times \frac{\$1.42}{1000 \text{ gal}} = \$17,786.00$

Blowdown: $\frac{\text{EVAP}}{\text{cycles}-1} = \frac{12,525,108 \text{ gal}}{2.5-1} \times \$1.42/1000 \text{ gal} = \$11,857.00$

Drift: .2% x Flow = $.002 \times 3000 \text{ gpm} \times \frac{60 \text{ min}}{\text{HR}} \times 8766 \frac{\text{HR}}{\text{YR}} \times \frac{\$1.42}{1000 \text{ gal}} = \$4,481.00$

CCF Chiller Plant Annual Energy Usage Cont.

Total Annual CCF Energy Usage = 6,200,017 KWH

Total Annual CCF Energy + Water Costs = $491,686.00

Totals with chiller plants Both in operation

Total Combined Annual LDCC + CCF Energy Usage = 11,117,195 KWH

Total combined Annual LDCC + CCF Energy + Water costs = $885,222.00

LDCC Energy Usage with Added CCF Cooling Load and Mechanical Room 189 Chilled Water Coil Load

900 ton Chiller – 90% Loaded

810 tons × 0.453 kw/ton × 8766 hrs/YR × $0.0738/kwh = $237,378.00

@ 3,216,508 kwh/YR

700 ton Chiller – (90% Loaded of 660 tons – converted to R-123)

593 tons × 0.58 kw/ton × 8766 hrs × $0.0738/kwh = $222,505.00

@ 3,014,978 kwh/YR

Primary chiller water pumps

15 hp × 2 pumps × .746 kw/hp × 8766 hrs/YR × 0.0738/kwh = $14,478.00

@ 196,183 kwh/YR

LDCC Secondary Pumps

40 hp × 2 pumps × .746 kw/hp × 8766 hrs/YR × $0.0738/kwh = $38,609.00

@ 523,155 kwh/YR

CCF Secondary pumps

40 hp × 2 pumps × .746 kw/hp × 8766 hrs/YR × $0.0738/kwh = $38,609.00

@ 523,155 kwh/YR

LDCC Energy Usage With Added CCF Cooling Load cont.

Primary Cooling Tower Pump

$125\ hp \times .746 \frac{kw}{hp} \times 8766 \frac{hrs}{yr} \times \$0.0738 \frac{}{kwh} = \$60,326.00$

@ $817,430 \frac{kwh}{yr}$

Secondary Cooling Tower pumps

$40\ hp \times 2\ pumps \times .746 \frac{kw}{hp} \times 8766 \frac{hrs}{yr} \times \$0.0738 \frac{}{kwh} = \$38,609.00$

@ $523,155 \frac{kwh}{yr}$

Cooling Tower Fans

← VFD operated (Assumption)

$40\ hp \times .70 \times 2\ Fans \times .746 \frac{kw}{hp} \times 8766 \frac{hrs}{yr} \times 0.0738 \frac{}{kwh} = \$27,026.00$

@ 366,208 KWH

Cooling Tower usage (EVAP. + Blowdown + Drift)

← compressor Heat

EVAP: $1.25 \times 1403\ tons \times 8766\ hrs/yr \times 12,000 \frac{Btuh}{ton} \times \frac{1\ lbw}{1000\ Btu} \times \frac{1\ gal}{8.346\ lbw} \times \frac{\$1.42}{1000\ gal} = \$31,388.00$

Blowdown: $\frac{EVAP}{cycles-1} = \frac{22,104,058\ gal}{2.5-1} \times \$1.42/1000\ gal = \$20,925.00$

Drift: .2% x flow = $.002 \times 6600\ gpm \times \frac{60\ min}{hr} \times \frac{8766\ hrs}{yr} \times \frac{\$1.42}{1000\ gal} = \$9,859.00$

Air Handling unit EC-1 Supply Fans

$11.56\ hp \times 3\ Fans \times .746\ kw/hp \times 8766 \frac{hrs}{yr} \times \$0.0738 \frac{}{kwh} = \$16,650.00$

@ $225,611 \frac{kwh}{yr}$

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CONSULTING ENGINEERS, INC.

JOB CCAL Chilled Water Sys' Opt-PL SHEET 7 OF 8
CALCULATED BY DSW DATE 10/16/01
CHECKED BY [illegible] DATE 10/16/01
3442.053.MCAL.002,Rev A SCALE JOB #
CONDENSED WATER Calc

LDCC Energy Usage With Added CCF cooling Load Cont.

Exhaust Fans EF-5, 6, & 7

7.6 bhp x 2 Fans x .746 Kw/hp x 8760 hrs/yr x $0.0788/Kwh = $7,336.00

@ 99,399 Kwh

Total Annual LDCC w/CCF Added Cooling Loads Energy usage = 9,505,782 KWH

Total Annual LDCC w/CCF Added cooling Loads Energy + Water costs = $763,698.00

Annual Energy + Cost Savings By Eliminating the CCF Chiller plant and CT-205.

Energy: 11,117,195 KWH − 9,505,782 KWH = 1,611,413 KWH
Costs: $885,222.00 − $763,698.00 = $121,524.00

Overall Savings

8 of 8

3442.053.MCAL.002,Rev A
CONDENSED WATER Calc

DGW

Received: from gateway.bpce.com
(bpce.com [207.108.252.130])
by BP3; Thu, 08 Feb 2001 15:08:31 -0700
Received: from mailhost.lanl.gov (mailhost.lanl.gov [128.165.3.12])
by gateway.bpce.com (8.11.1/8.11.1) with ESMTP id f18M8SC25261
for <MAS@bpce.com>; Thu, 8 Feb 2001 15:08:28 -0700
Received: from beasley.lanl.gov (beasley.lanl.gov [128.165.3.13])
by mailhost.lanl.gov (8.10.1/8.10.1/(cic-5, 6/12/00)) with ESMTP id f18M8Sg23479
for <MAS@bpce.com>; Thu, 8 Feb 2001 15:08:28 -0700
Received: from earz (earz.lanl.gov [128.165.26.69])
by beasley.lanl.gov (8.9.3/8.9.3/(cic-5, 2/9/99)) with ESMTP id PAA03331
for <MAS@bpce.com>; Thu, 8 Feb 2001 15:08:24 -0700 (MST)
Message-Id: <4.2.2.20010208144640.0105e230@fss-mail.lanl.gov>
X-Sender: u100721@fss-mail.lanl.gov
X-Mailer: QUALCOMM Windows Eudora Pro Version 4.2.2
Date: Thu, 08 Feb 2001 15:07:06 -0700
To: "Michael Slaman" <MAS@bpce.com>
From: "Emilio A. Racinez, PE" <eracinez@lanl.gov>
Subject: Re: LANL - User utility rates
In-Reply-To: <sa800cda.057@BP3>
Mime-Version: 1.0
Content-Type: text/plain; charset="us-ascii"; format=flowed

Mike,

TA-18 Utility billings are based on per square ft.
There are no electric or gas meters at TA-18 that are used
for collecting energy usages. A one time electric energy usage
profile was made and this is the basis for the billings.

8/27/01
Gas & Steam
$3.93/FT²/year

Gas for heating Lab-wide is per sq ft also. the Laboratory pays ~~$8.40~~ /Dtherm. The following are the rates for TA-18:

Heat (gas) $0.29664167/sq ft/month = fixed $ 14,159.30/month
Electric fixed $44,966.51/month

The following are the Laboratory rates:

Heat(gas, steam) ~~$3.5597~~ $3.93/sq ft/year
Water & Wastewater $2.0027/sq ft/year

Electric Rate:
Small & profiled users $0.0872/KWH
Large users with demand charge $0.0738/KWH This would apply to TA-55

Demand charge NOT

Current 8/27/01

I hope this helps.

Emilio

PAT Archer 665-5052
Bill Baker 667-7756
WM

At 02:39 PM 2/6/01 -0700, Michael Slaman wrote: